

## EPS/OEB 56: Geobiology and the History of Life

**Meeting:** MWF 10:00-11:00 a.m. and a 2-3 hour lab section each week

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**Description:** Within our solar system, Earth is distinguished as the planet with life. Life was born of planetary processes, has been sustained for some four billion years by planetary processes, and through time has emerged as a set of planetary processes that is important in its own right. In this course, we will investigate the ways that Earth and life interact, focusing in particular on the biogeochemical cycles of major elements. This will provide a framework for interpreting the history of life reconstructed from fossils and phylogeny.

**Prerequisites:** Any of the following classes: EPS 21, EPS 22, OEB 10, or permission from the instructor.

**Grading system:** 20% weekly lab assignments  
20% mid-term  
15% response paper I  
15% response paper II  
30% final exam

**Field trip:** 1 day, April 25<sup>th</sup> (to be confirmed early in the semester)

**Reading:** Reading assignments are provided for each lecture. These will primarily be from the course text, but will also include a moderate number of other, accessible articles.

**Response papers:** During the term you will be responsible for writing two brief (3-4 pages) response papers based on course readings from the primary literature.

## Lecture and Lab schedule

- M Jan 26: Introduction (AK, DJ)  
W Jan 28: Uniformitarianism: processes and rates (AK)  
F Jan 30: Today's world – the atmosphere (DJ) ([Kump, reserve book, Ch 3](#))

No lab this week.

- M Feb 2: Today's world: the ocean and underlying sediments (DJ)  
W Feb 4: Today's world: phylogeny and biological diversity (AK)  
F Feb 6: The record of life in sedimentary rocks (AK) ([Stanley Ch. 1; Virgilli, 2007](#))

LAB 1: the rock cycle ([Stanley Ch. 2](#))

- M Feb 9: The record of physical environments in sedimentary rocks (AK)  
W Feb 11: Time and stratigraphy (AK) ([Stanley Ch. 6](#))  
F Feb 13: The Earth: Origin and Early Evolution (DJ) ([Hazen and Ferry, 2010](#))

LAB 2: The nature of sedimentary rocks and sedimentary structures ([Stanley Ch. 5](#))

- M Feb 16: Holiday (Presidents' Day)  
W Feb 18: The Archean Earth System (DJ) ([Stanley Ch. 11](#))  
F Feb 20: The Origin of Life (AK) ([Ricardo and Szostak, 2009](#))

LAB 3: More on sedimentary rocks

- M Feb 23 The Great Oxidation Event I (DJ) ([Kump, 2008; Stanley Ch. 12](#))  
W Feb 25 Eukaryotic radiation (AK) ([see Stanley Ch. 1 again](#))  
F Feb 27 Proterozoic life and environments (AK) ([Poulton and Canfield, 2011](#))

LAB 4: Stromatolites and microfossils: The fossil record of early life

- M Mar 2 Neoproterozoic ice ages (DJ) ([Hoffman, 2009](#))  
W Mar 4 Revisiting the linkage between different geochemical cycles (DJ)  
F Mar 6 Ediacaran environmental history (DJ)

LAB 5: Review Session

- M Mar 9 MID-TERM EXAM  
W Mar 11 The dawn of animal life (AK) ([Xiao and LaFlamme, 2008](#))  
F Mar 13 The Cambrian radiation of animals I (AK) ([Stanley Ch. 13; Dove, 2010](#))

LAB 6: The great oxidation event and redox

**SPRING BREAK**

- M Mar 23 The Cambrian radiation of animals II (AK) ([Stanley Ch. 13; Dove, 2010](#))  
W Mar 25 Biogeochemical consequences of animal radiation (DJ)  
F Mar 27 Paleozoic environments (DJ) ([Stanley Ch. 14](#))

LAB 7: The nature of animal fossils

- M Mar 30 Ordovician radiation in the oceans (AK)  
W Apr 1 Paleozoic marine life and extinctions (AK)  
F Apr 3 Plants and animals colonize land (AK)

LAB 8: Paleozoic animals in the oceans

- M Apr 6 End-Permian mass extinction (AK)  
W Apr 8 The Triassic recovery (AK)  
F Apr 10 Oceanic anoxic events (DJ)

LAB 9: The fossil record of land plants

- M Apr 13 The Mesozoic marine revolution of animals (AK) ([Stanley Ch. 15, 16](#))  
W Apr 15 The Mesozoic marine revolution of plankton (AK) ([Takashima et al., 2006](#))  
F Apr 17 End-Cretaceous mass extinction (AK)

LAB 10: Mesozoic and Cenozoic animals in the oceans

- M Apr 20 Cenozoic climate change (DJ) (Stanley Ch. 18, 19)  
W Apr 22 The Pleistocene ice age (DJ)  
F Apr 24 Evolution in the context of Cenozoic climate change and anthropocene (AK)

LAB 11: Field trip preparation

APRIL 25<sup>th</sup> Field trip to upstate NY.

- M Apr 27 Anthropocene climate and what is to come (DJ)  
W Apr 29 Reflecting on comparisons between the early Earth and today (DJ)

## READINGS

*Textbook:* Stanley, S.M. and J.A. Luczac (2014) Earth System History, 4<sup>th</sup> Edition. W. H. Freeman, ISBN-13: 978-1429255264.

*On reserve at Cabot:* Selected readings from Kump, L.R., J.F. Kasting and R.G. Crane (2008) The Earth System (3rd Edition). Prentice Hall, 432 pp. ISBN-13: 978-0321597793

### *Additional Readings:*

Dove, P.M. (2010) The rise of skeletal biominerals. *Elements* 6: 37-42.

Hazen, R.M. and J.M. Ferry (2010) Mineral evolution: mineralogy in the fourth dimension. *Elements* 6: 9-12.

Hoffman, P.F. (2009) Neoproterozoic glaciation. *Geology Today* 25: 107-114.

Kump, L.R. (2008) The Rise of atmospheric Oxygen. *Nature*: 277-278.

Poulton, S.W. and D.E. Canfield (2011) Ferruginous conditions: a dominant feature of the ocean through Earth's history. *Elements* 7: 107-112.

Ricardo, A. and J. Szostak (2009) Origins of life on Earth. *Scientific American* 301, Issue 3, Special Issue: 54-61.

Takashima, R. et al (2006) Greenhouse world and the Mesozoic Ocean, *Oceanography* 19(4): 82-92.

Virgili, C. (2007) Charles Lyell and scientific thinking in geology. *Comptes Rendus Geoscience* 339: 572-584.

Xiao S.H. and M. Laflamme (2008) On the eve of animal radiation: phylogeny, ecology and evolution of the Ediacara biota. *Trends in Ecology and Evolution* 24: 31-40.